UNIVERSITEIT GENT

FACULTY OF BIOSCIENCE ENGINEERING

Determination of physical–chemical conditions to predict macroinvertebrate communities in Machangara River (Southern Andes, in Ecuador)

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RESEARCH GROUP AQUATIC ECOLOGY

Laboratory of Environmental Toxicology and Aquatic Ecology

OUTLINE

- Background and objective
- Materials and methods
- Results
- Conclusion

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1-BACKGROUND AND OBJECTIVE

- Destruction of native vegetation.
  - Fuelwood
  - Land for livestock and agriculture
- High flow variation for dams presence
- Main source of water supply for the Cuenca City.
- Necessity to improve actual conditions

Objective

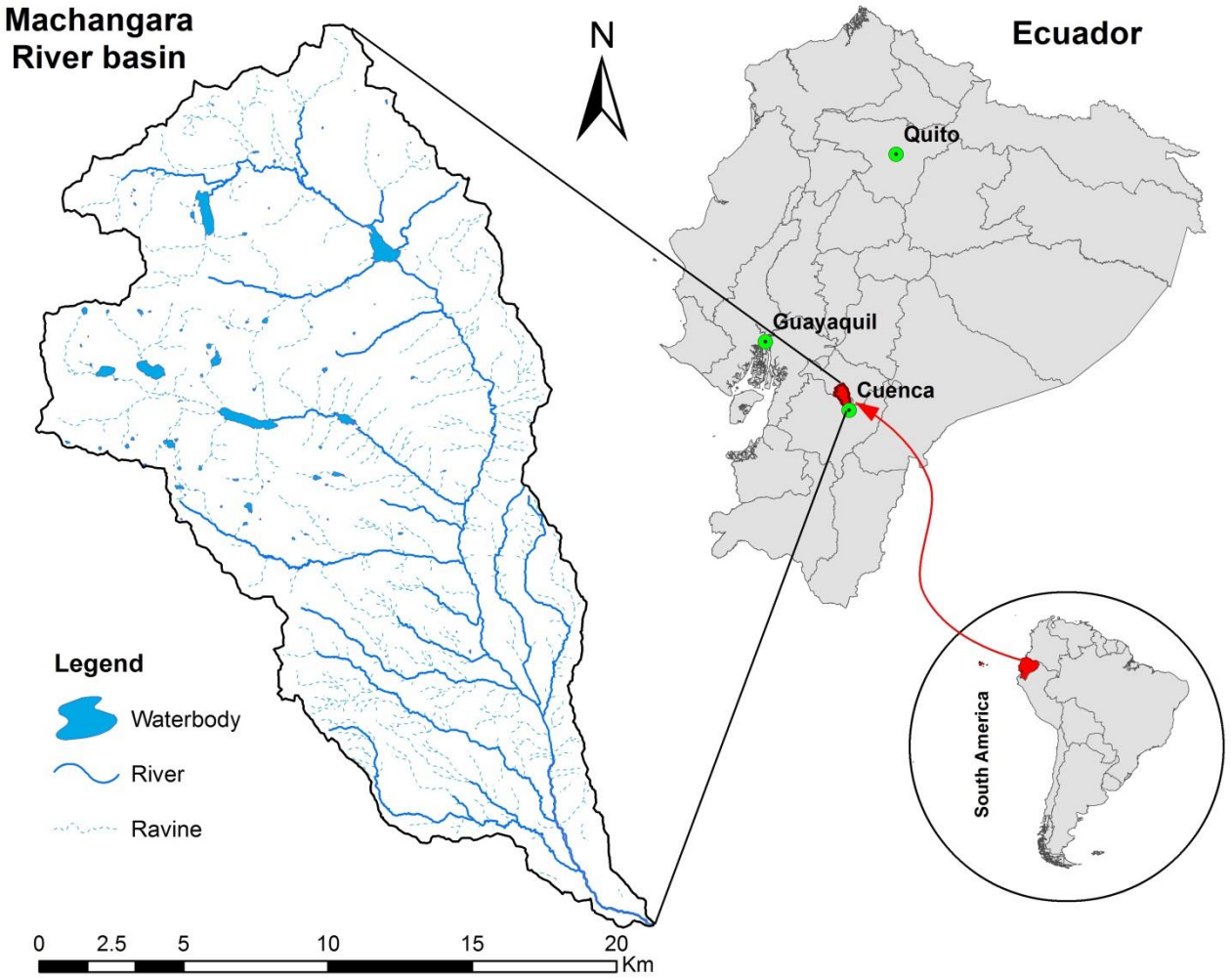
- Construction of Habitat Suitability Model (HSM) as decision makers tool

.

- How is the variation of the Ecological Water Quality (EWQ) in the basin?

2- MATERIALS AND METHODS

LOCATION:



MODSIM2015, Gold Cost, Australia, Date (03,12, 2015)
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BASIN CHARACTERISTICS:

- Area: 325 Km^2
- Protected Forest: 252 Km^2
- Altitude:

  2,450 to 3,850 masl
- Annual Rainfall:

  877 to 1,363 mm/year
- Average Temperature:

  16.3 to 9 ^oC

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BASIN CHARACTERISTICS:

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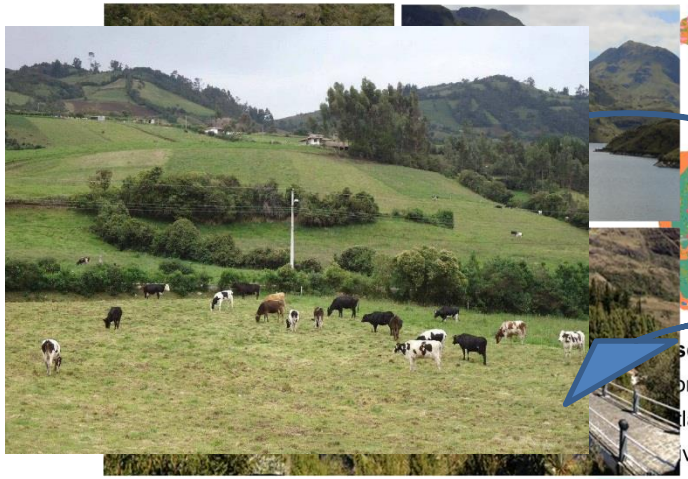
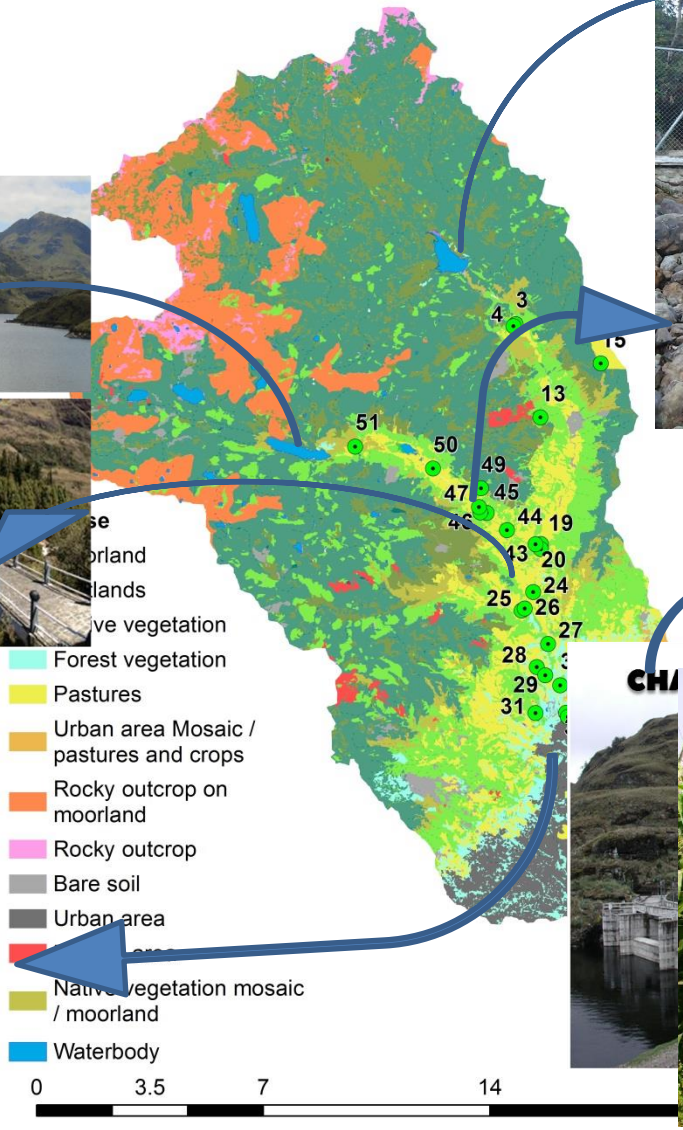
LAND USE





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DATA COLLECTION:

- 44 sampling locations
- Completed information on 33 locations

Physicochemical, hydraulic, microbiological

- **Laboratory**
  - BOD_5, COD, Nitrate + Nitrite, Ammonia, Organic Nitrogen, Phosphates, Total Phosphorus, Fecal and Total Coliforms, Real Color, Turbidity, Total Solids
- **Field:** Flow Velocity, Ph, Conductivity, Temperature, Dissolved Oxygen

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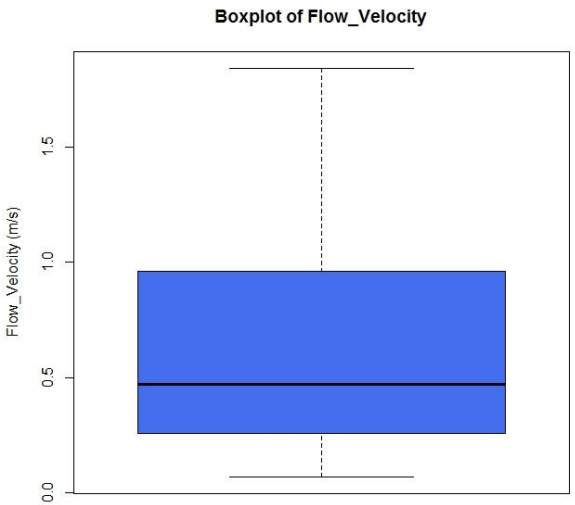
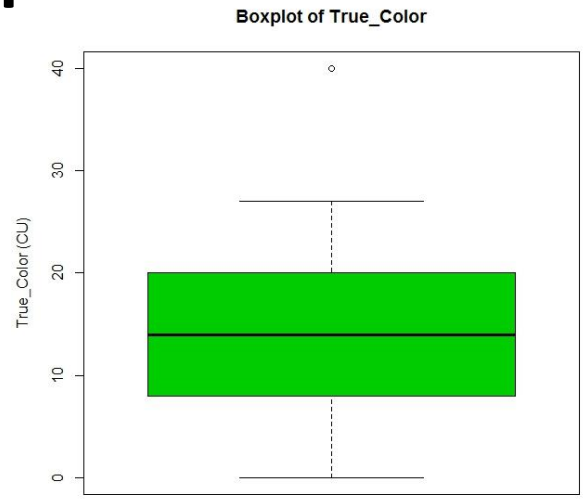
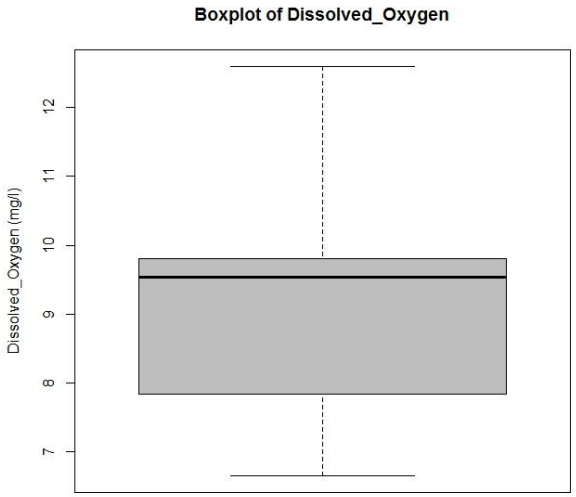
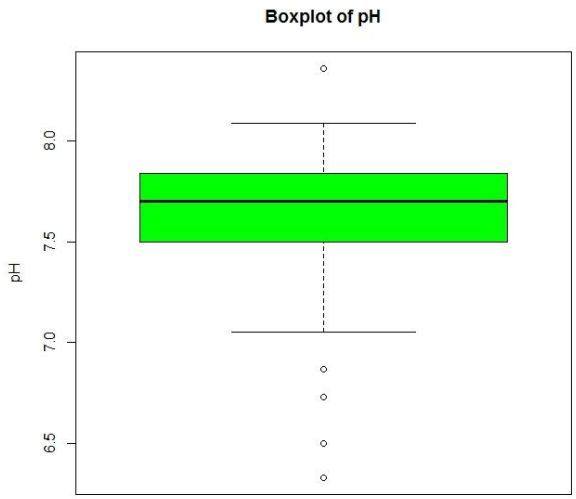
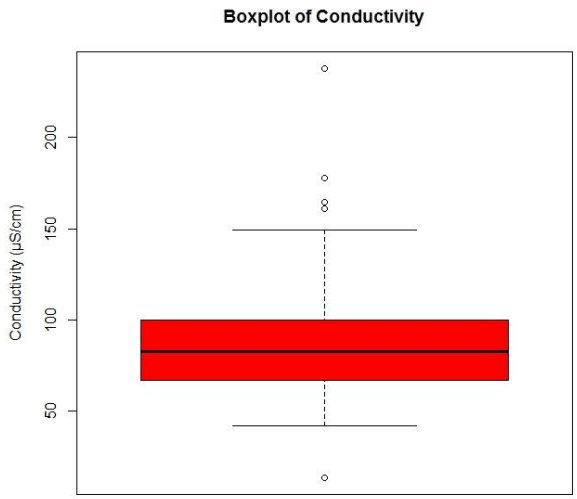
Variables Variation











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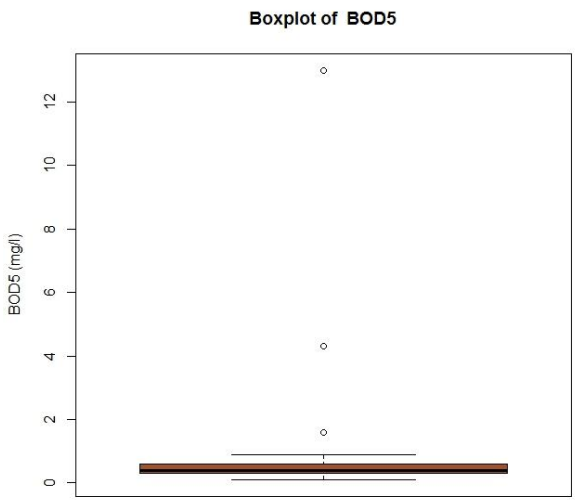
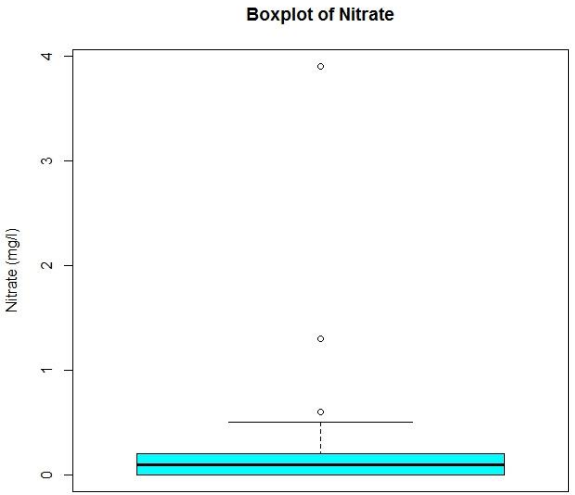
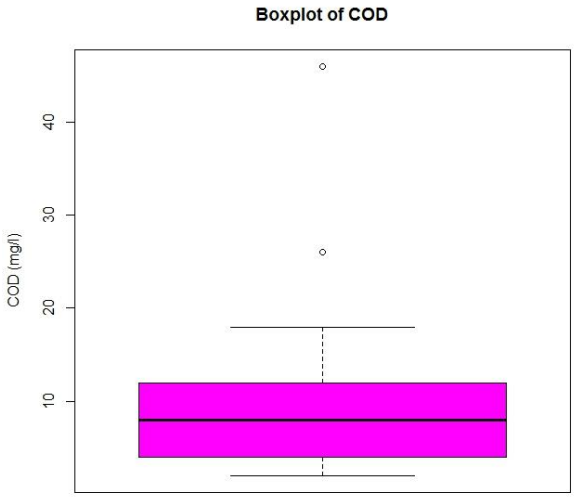
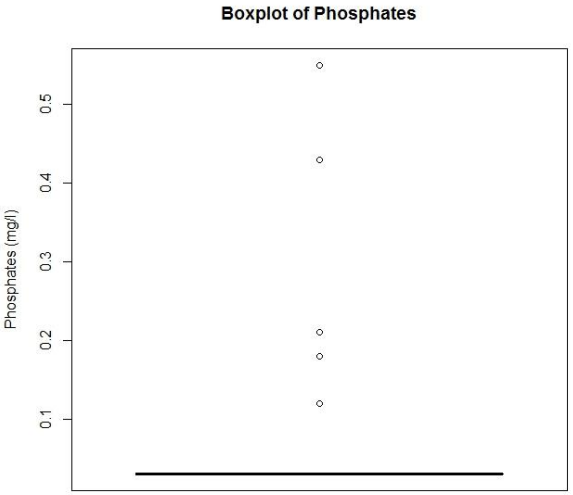
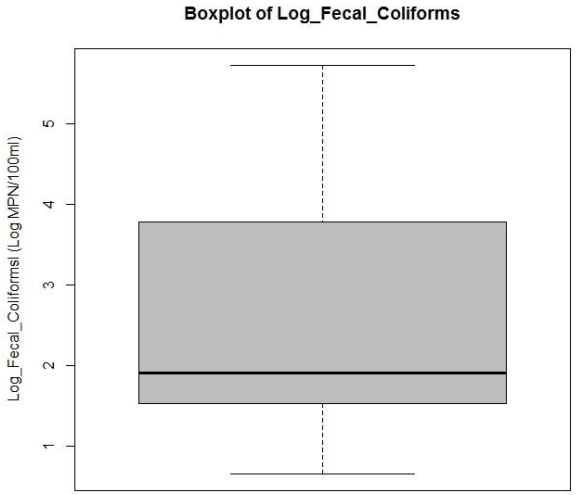
Variables Variation











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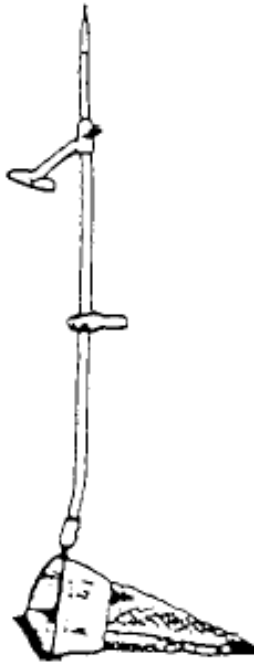
DATA COLLECTION:

Macrobenthos

- Kick Sweep Method
  - 3 minutes in 2.5 m^2
  - Two times in same are
  - Standard net
- Identified a family level
  - Stereoscope
  - Identification Keys
- 39 families (taxa) found



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ECOLOGICAL WATER QUALITY

- Biological Monitoring Working Party Index - Col
- BMWP-Col = f(Sensitivity of Macrobenthos)
- Sensitivity -> 1-10 (Low – High Sensitivity)

Class	Quality	BMWP	Color
I	Very Good	> 100	
II	Good	61 - 100	
III	Regular	36 - 60	
IV	Bad	16 - 35	
V	Critical	≤ 15	

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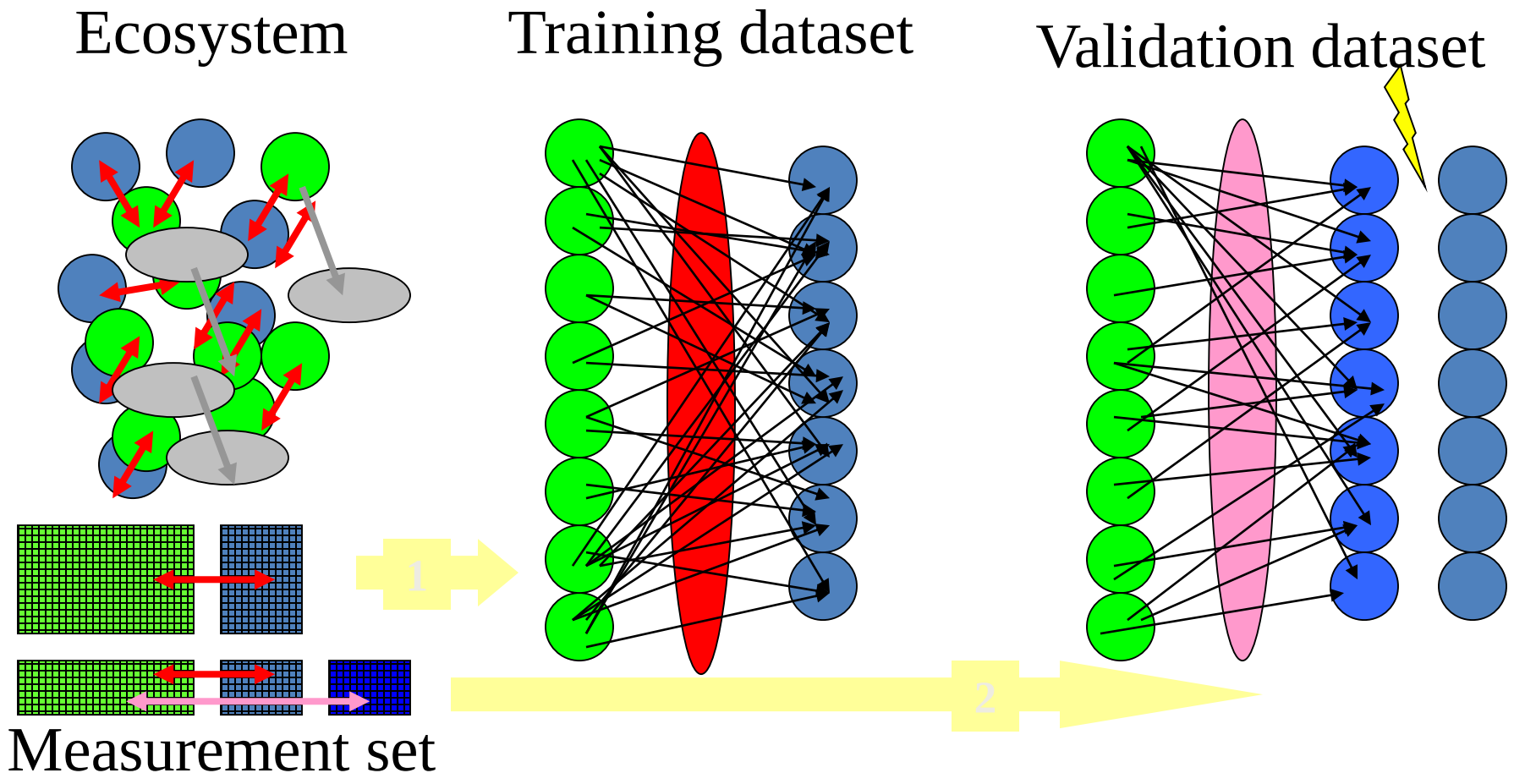
Model development



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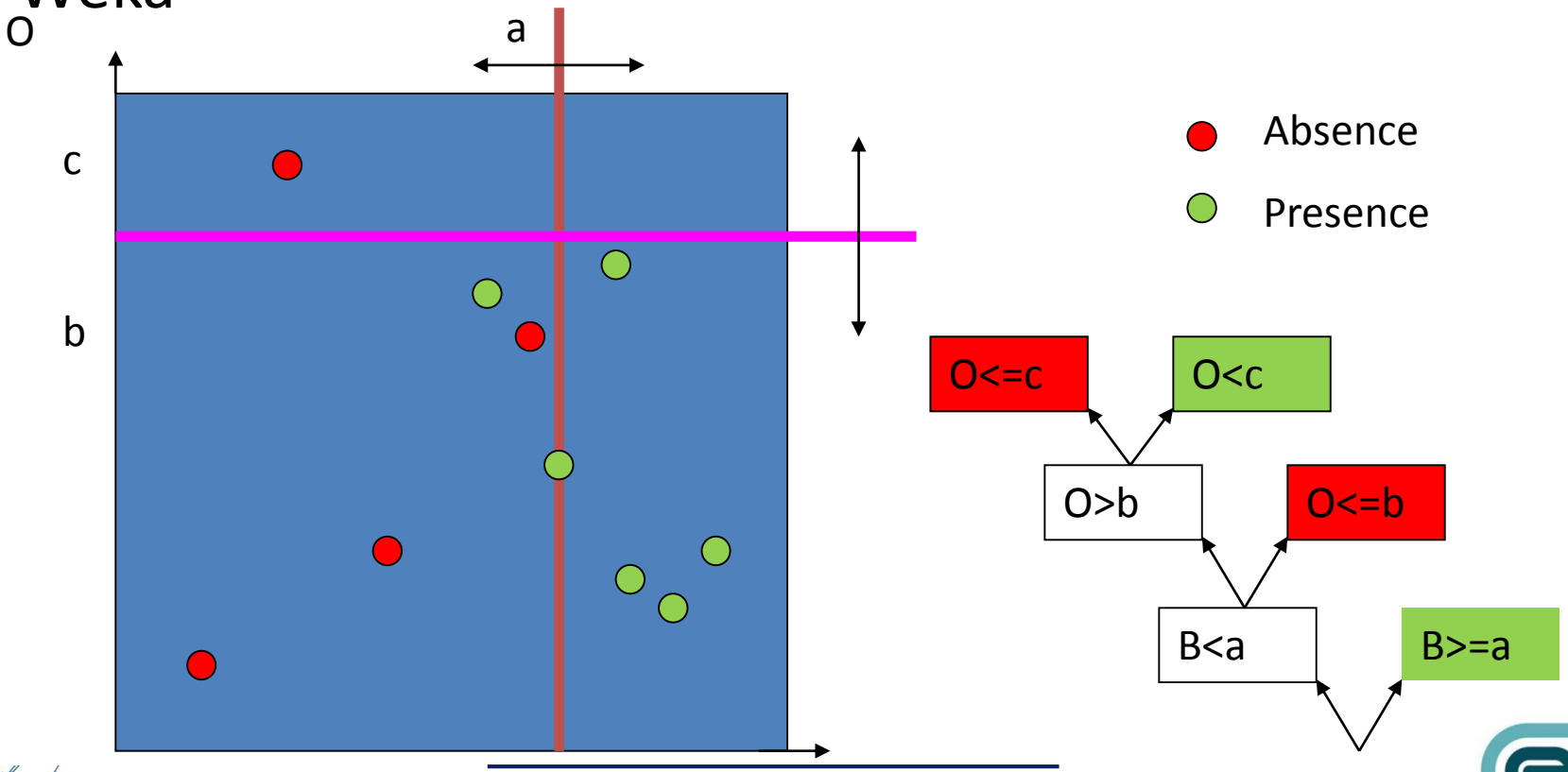
Methodology
Pruned Multi-target Clustering Trees (PMCT)

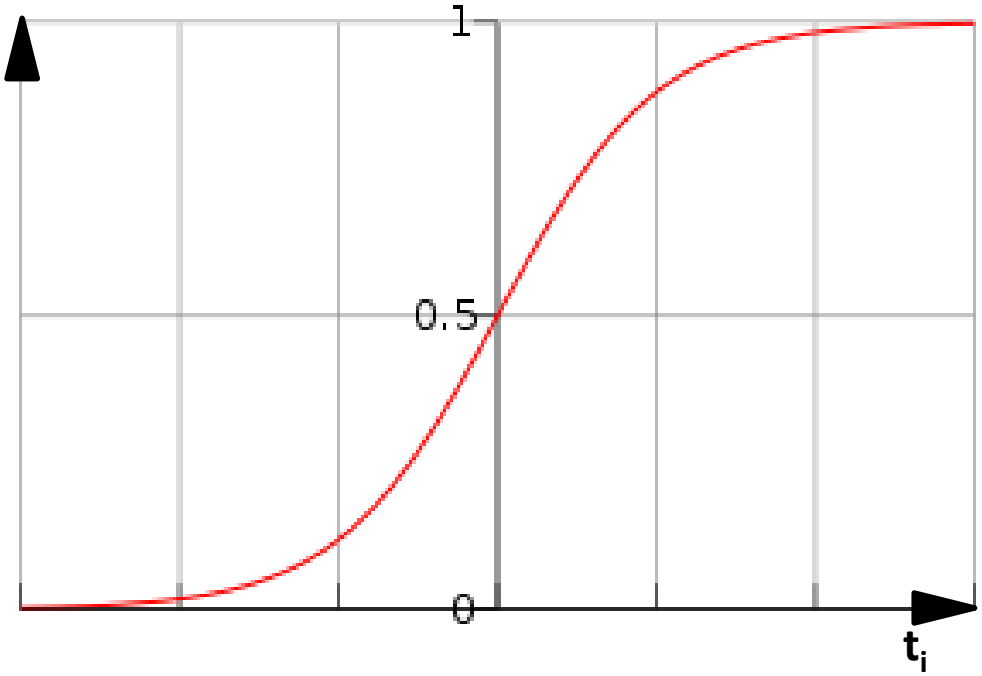
- Classification trees: searching for if-then rules (threshold values): 100% reliable and ‘safe’ models
- Weka



Methodology
Generalized Linear Model (GLM)

- Binomial fitting – Presence and Absence
- R

$$\pi(t_1, \ldots . tn) = \frac{e^{(-ao - a_1 x t_1 - \ldots\ldots\ldots - a_n \times t_n)}}{1 + e^{(-ao - a_1 x t_1 - \ldots\ldots\ldots - an \times t_n)}}$$



t_i = Variable i

0 = Absence

1 = Presence

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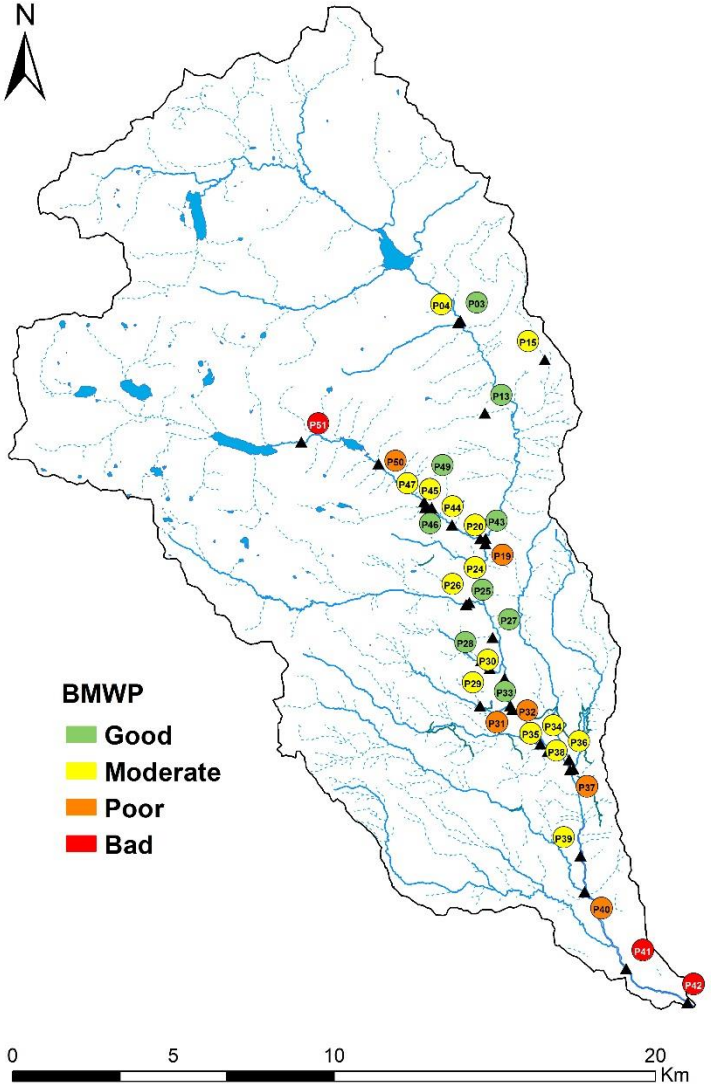
3- RESULTS ECOLOGICAL WATER QUALITY



BMWP-Col:

- 9 good
- 15 moderate
- 6 poor
- 3 bad

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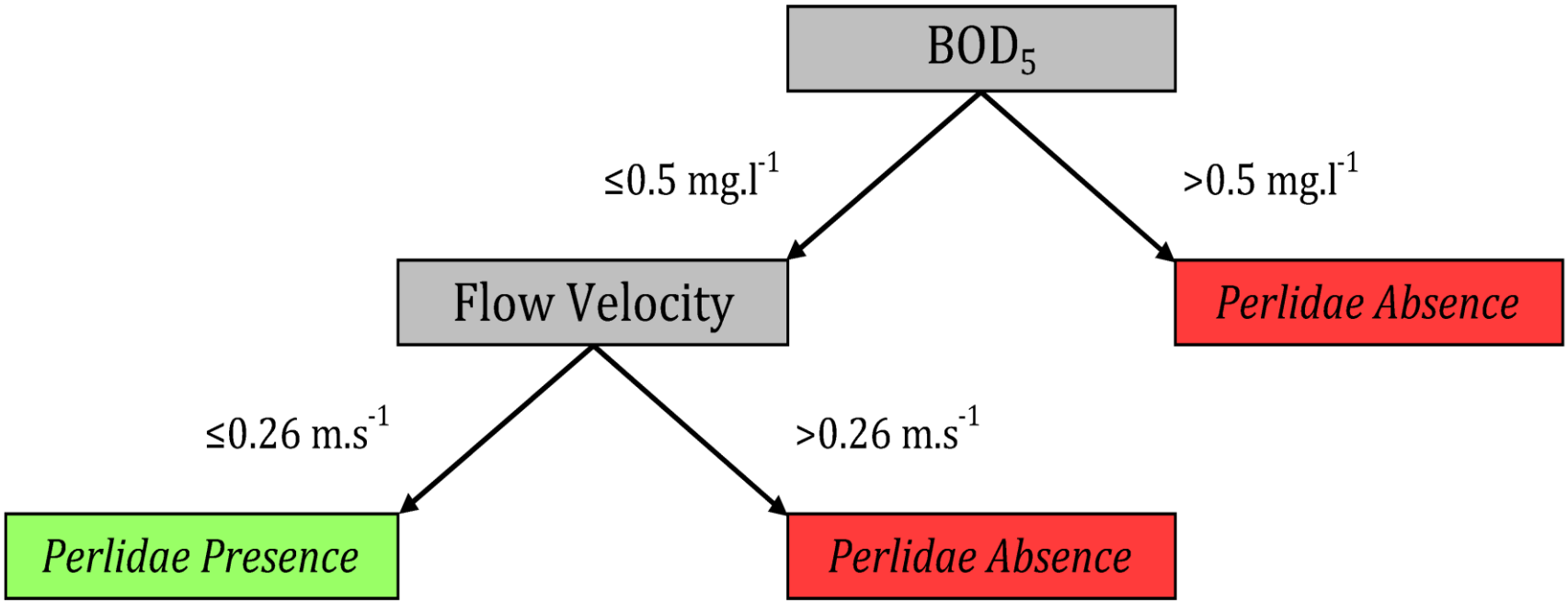
Perlidae (Plecoptera)



CCI = 73%

Cohen´s Kappa Statistic = 0.44

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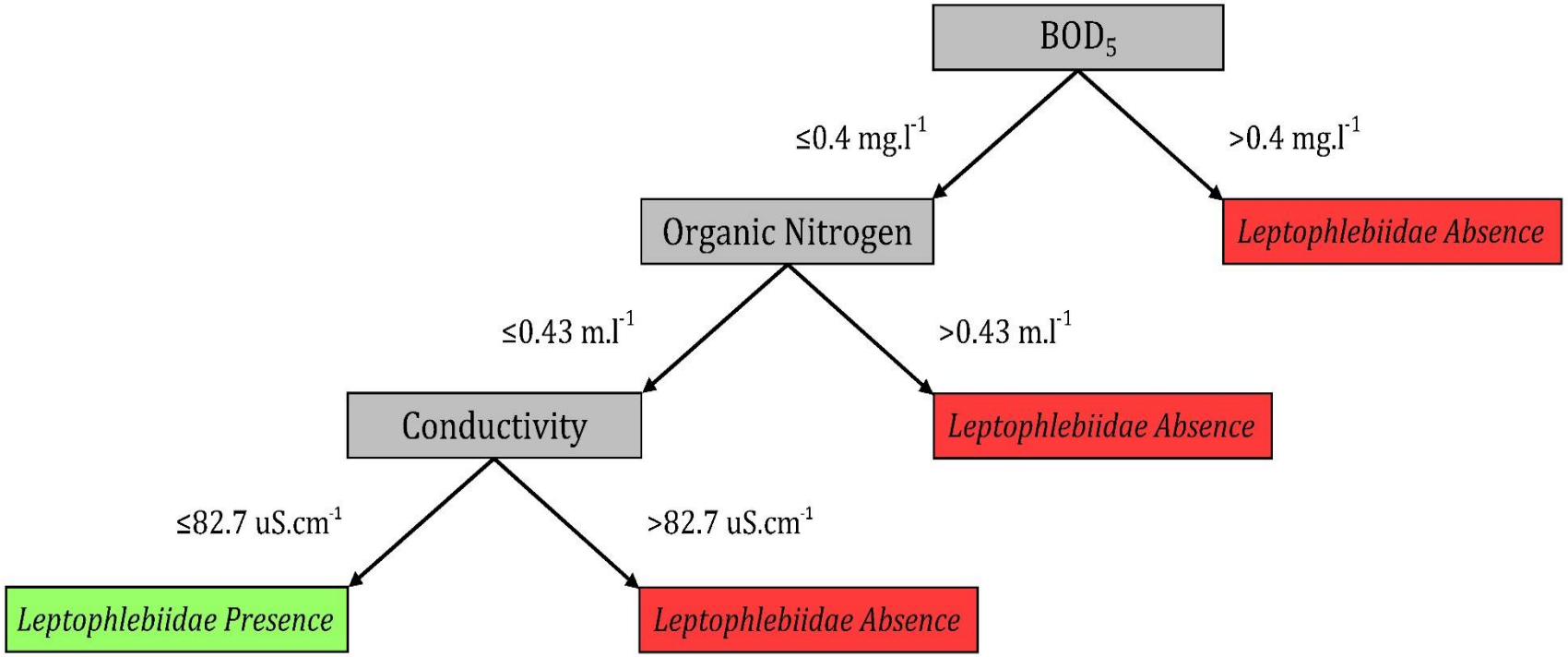
Leptophlebiidae (Ephemeroptera)



CCI = 79%

Cohen´s Kappa Statistic = 0.45

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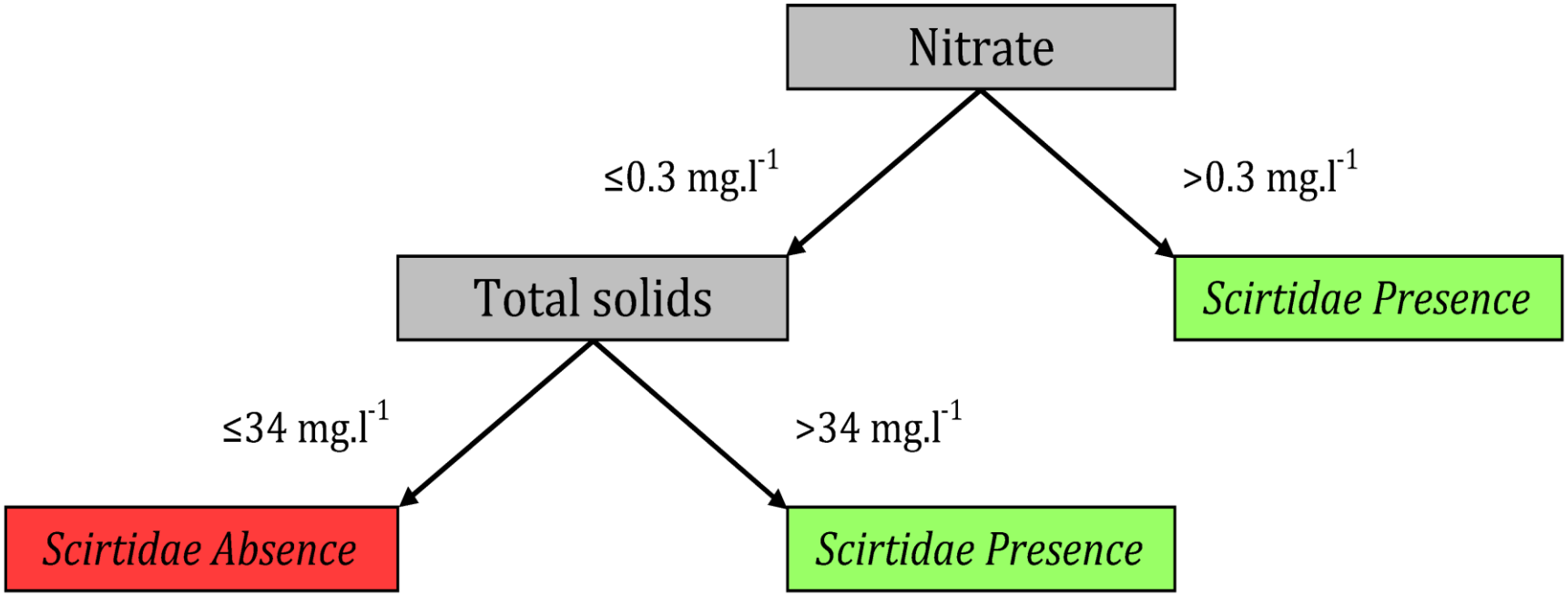
Scirtidae (Coleoptera)



CCI = 73%

Cohen´s Kappa Statistic = 0.42

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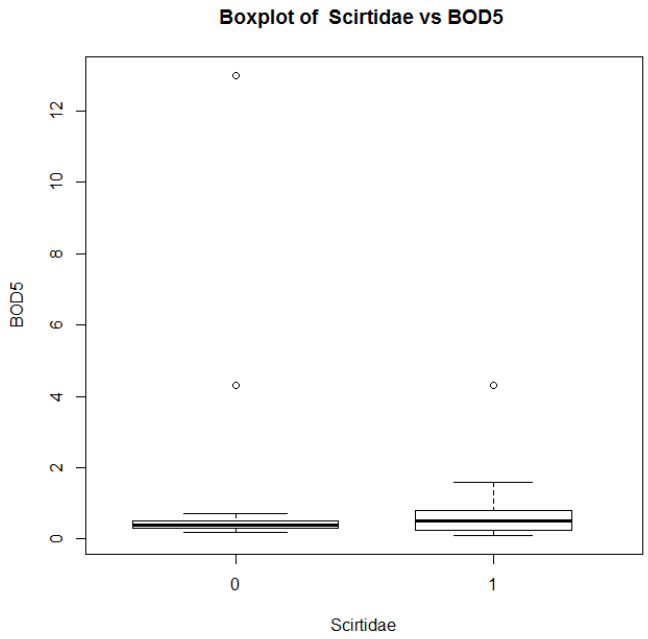
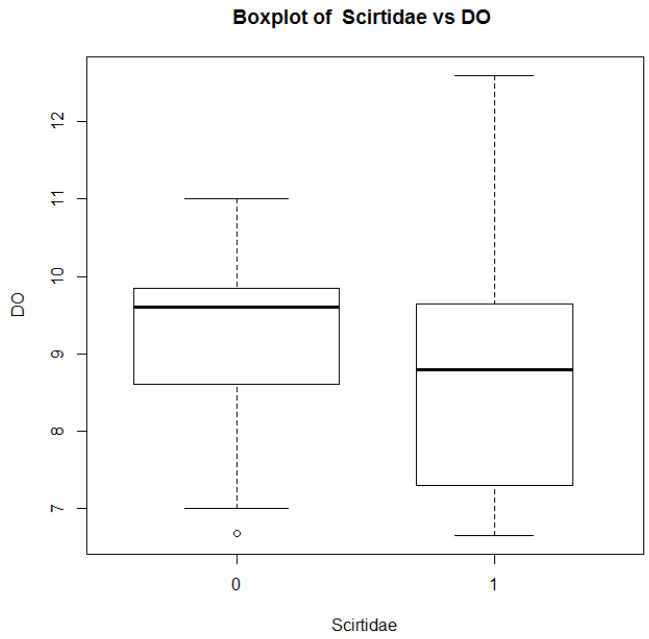
Scirtidae (Coleoptera) (R^2=59%, AIC=29.8)

$$\pi = \frac{e^{(-21.4619 - 11.6893 \times \boldsymbol{BOD_5} + 1.4126 \times \boldsymbol{DO} + 0.8286 \times \boldsymbol{COD} + 56.7596 \times \boldsymbol{Nitra.Nitri} + 140.335 \times \boldsymbol{Phosph})}}{1 + e^{(-21.4619 - 11.6893 \times \boldsymbol{BOD_5} + 1.4126 \times \boldsymbol{DO} + 0.8286 \times \boldsymbol{COD} + 56.7596 \times \boldsymbol{Nitra.Nitri} + 140.335 \times \boldsymbol{Phosph})}}$$





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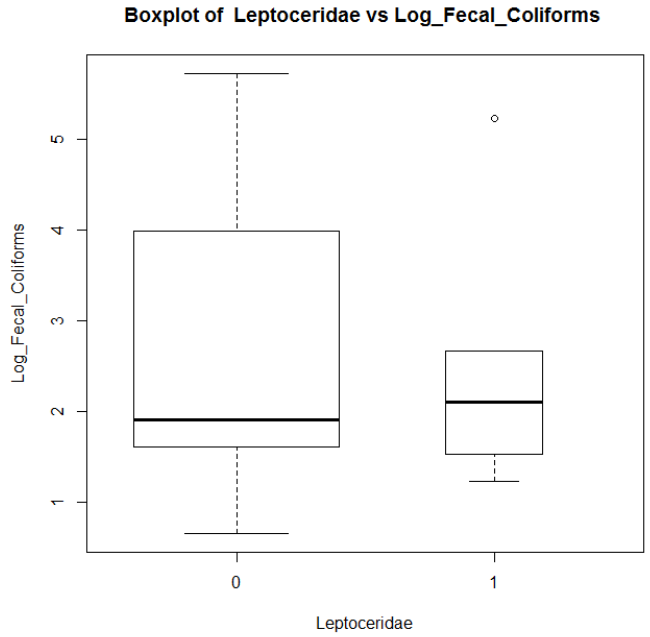
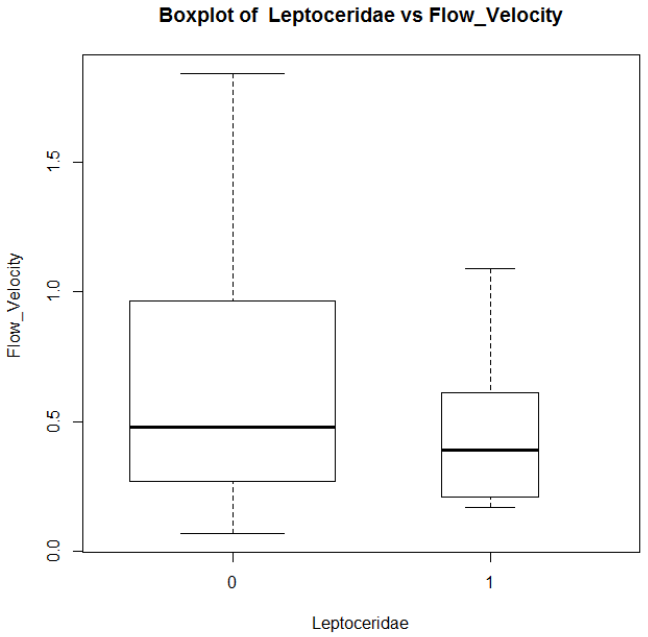
Leptoceridae (Trichoptera) (R^2=68%, AIC=26.5)

$$\pi = \frac{e^{(50.4797 + 6.4095 \times Lg_{F_{Colif}} - 12.2656 \times Fl_{Vel} - 12.4040 \times BOD_5 - 5.3051 \times pH - 1.1153 \times COD - 0.0775 \times Cond)}}{1 + e^{(50.4797 + 6.4095 \times Lg_{F_{Colif}} - 12.2656 \times Fl_{Vel} - 12.4040 \times BOD_5 - 5.3051 \times pH - 1.1153 \times COD - 0.0775 \times Cond)}}$$





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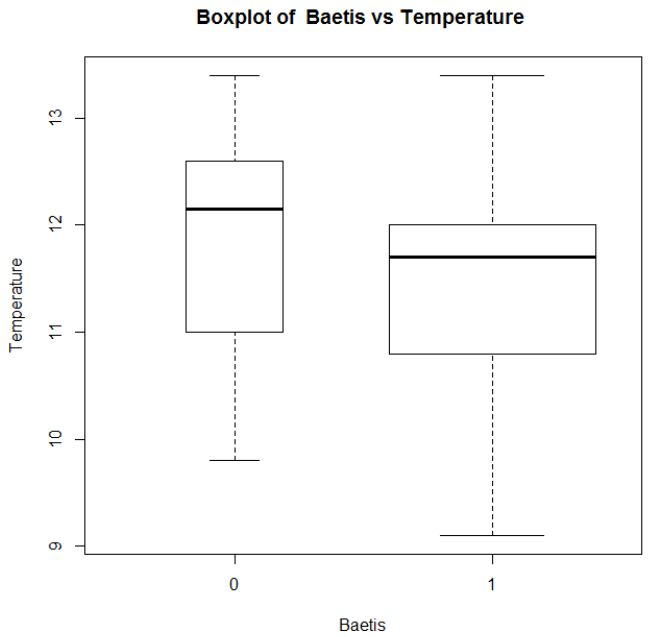
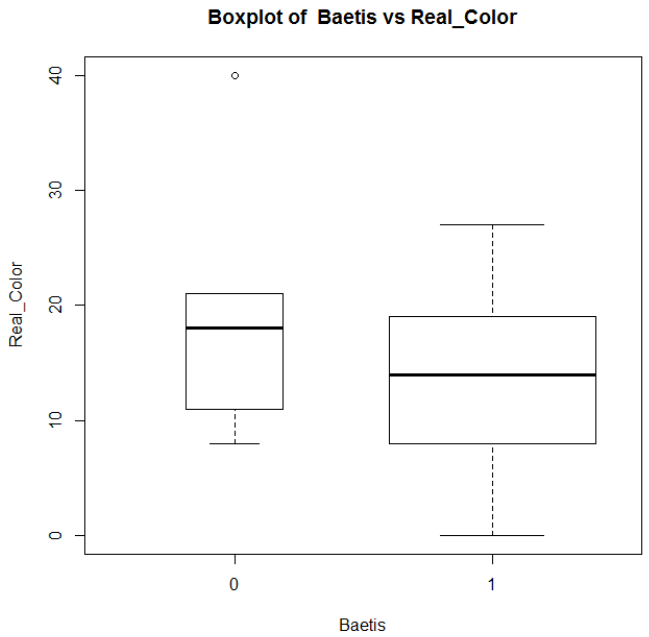
Baetis (Ephemeroptera) (R^2=60%, AIC=22.5)

$$\pi = \frac{e^{(26.9459 - 2.8553 \times \boldsymbol{Tem} - 0.4083 \times \boldsymbol{T\_Color} + 0.1293 \times \boldsymbol{Cond} + 0.7462 \times \boldsymbol{COD})}}{1 + e^{(26.9459 - 2.8553 \times \boldsymbol{Tem} - 0.4083 \times \boldsymbol{T\_Color} + 0.1293 \times \boldsymbol{Cond} + 0.7462 \times \boldsymbol{COD})}}$$





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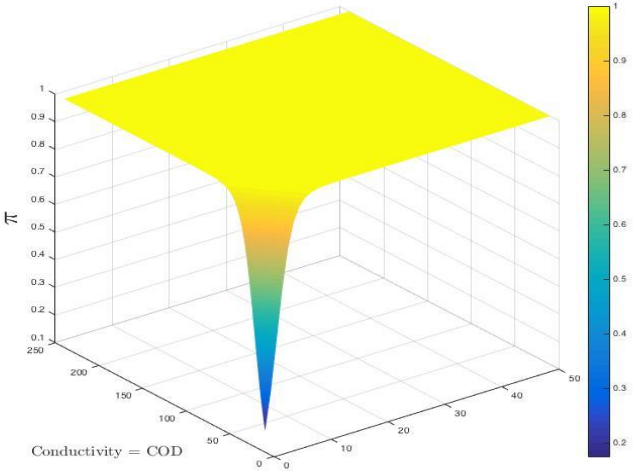
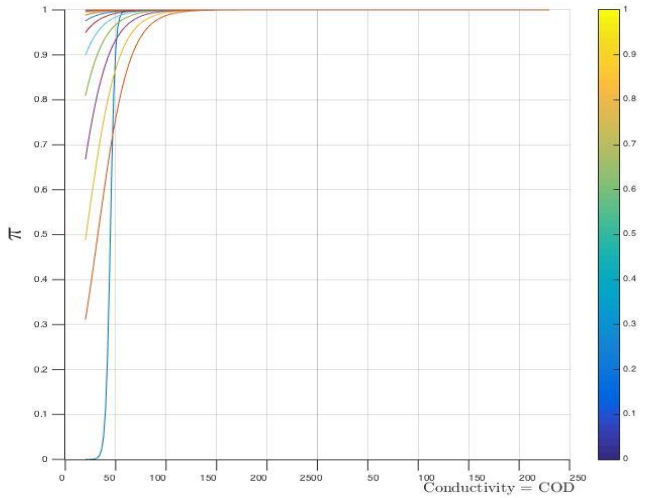
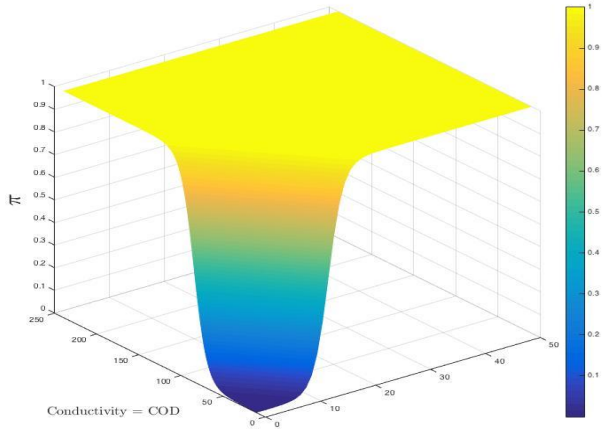
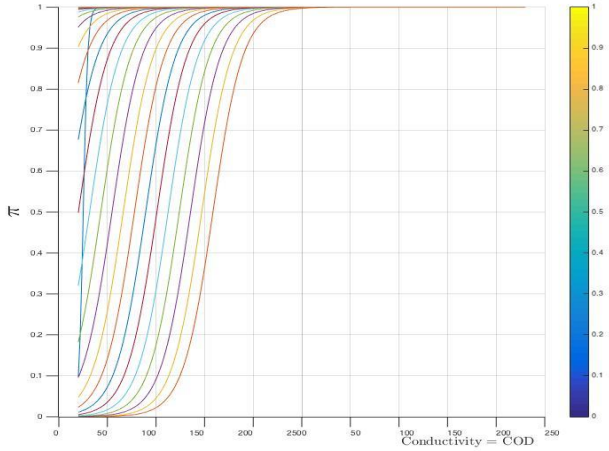
Baetis (Ephemeroptera)









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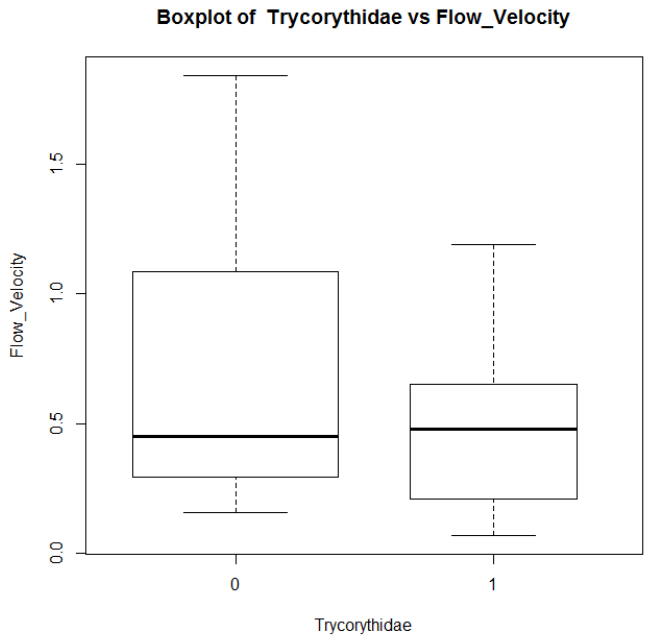
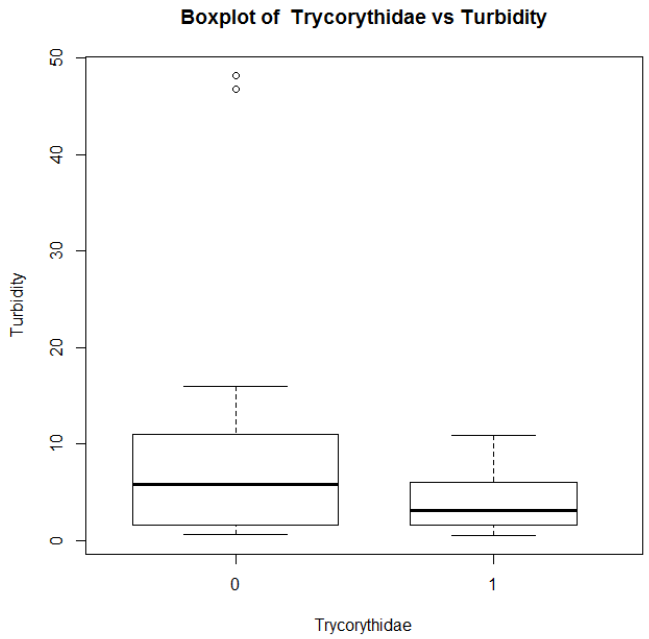
Trycorythidae (Ephemeroptera) (R^2=60%, AIC=31.9)

$$\pi = \frac{e^{(-21.0763+3.5121\times \boldsymbol{Fl_{Vel}}-1.4066\times \boldsymbol{Turb}-1.2660\times \boldsymbol{Tem}+3.3683\times \boldsymbol{pH}+0.0947\times \boldsymbol{Cond}+419.2533 \boldsymbol{T\_Phosph})}}{1+e^{(-21.0763+3.5121\times \boldsymbol{Fl_{Vel}}-1.4066\times \boldsymbol{Turb}-1.2660\times \boldsymbol{Tem}+3.3683\times \boldsymbol{pH}+0.0947\times \boldsymbol{Cond}+419.2533 \boldsymbol{T\_Phosph})}}$$





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4- CONCLUSION AND FUTURE WORK

- Habitat Suitability Model (HSM) ->
  Predict absence or presence of some taxa

- *The statistical models are a Good Fit*
- *EWQ =*
  Critical -> Absence of { Leptophlebiidae, Trycorythidae, Leptoceridae and Scirtidae.

- *Models analyzed ->*
  { potentially used as decision support tools in river basin management

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Acknowledgement

- VLIR-UOS IUC Programme - Universidad de Cuenca
- VLIR Ecuador Biodiversity Network Project
- Consejo de la Cuenca del Río Machángara

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Thank you

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